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Editorial

Radical Changes in Infertility Practice: It Is Coming Soon

Infertility is a medical, personal, and public health problem in all human societies that affects about 15% of couples of reproductive ages, being the significant concern of patients, doctors, and health policymakers worldwide during the last decade. The spread of assisted reproductive technologies (ARTs) has facilitated the diagnosis and treatment of infertility in most countries; however, the total number of children born from IVF is less than 0.2% of the world's population, although 1-5% of neonates are conceived by ART in some countries. Recently, ARTs have been transformed in terms of variety and quality for their wider application in correction of gene defects, treatment of genetic diseases, and gene therapy along with genetic modifications in the livestock industry. The main incentive for the advancements was the relatively low efficiency of ART outcomes and the increasing need for their implementation in the treatment of infertility (1).

One of these areas of progress is the growing application of artificial intelligence (AI) in the clinical aspects of human reproduction and infertility through the integration of medicine and computer science using machine learning algorithms. Artificial intelligence has been utilized for nearly two decades in various fields of human reproduction, including diagnosis of infertility and prognosis of treatment outcomes in the form of chemical/clinical pregnancies, live births, and repeated IVF failures. Moreover, the technology has been applicable in evaluation of ovarian reserve, ultrasound assessment of follicles growth in IVF cycle, determining endometrial quality, and its potential for embryo implantation, as well as sperm, egg, and embryo selection. Therefore, replacement of existing invasive methods with non-invasive ones based on artificial intelligence is not far from expected. In the field of male reproductive health, AI is being developed from Computer-Assisted Semen Analysis (CASA) systems to the applications evaluating environmental factors and lifestyle for predicting sperm quality. Furthermore, AI is perceived as a utilitarian alternative in diagnosing the causes of idiopathic infertility based on the biological and clinical symptoms of infertile couples (2).

In addition to the development and expansion of AI application among experts in the fields of fertility and infertility, its function in basic research and clinical practice serves as an ancillary and supportive mechanism in infertility treatment. In this context, another important aspect worthy of paramount attention is the very rapid expansion of AI among community, especially among infertile couples and recipients of ART services. In the past, people with different levels of knowledge and ability had limited access to scientific and medical databases. Their education mainly hinged upon public databases and commercial websites, which provided incomplete data or sometimes conflicting information. Their reliance on untrustworthy sources could jeopardize their health and result in adverse medical and economic consequences for both themselves and the healthcare system (3).

Infertile couples usually surf the net for quick access to fertility care information. For instance, A query for the term "infertility" on Google brings millions of results, many of which have not been verified for scientific and medical validity. Most of commercial websites with pseudo-scientific data use SEO techniques to improve their ranking in the top list of search results, occasionally deceiving the naïve users to sell their products or attract more customers. In fact, most people believe that the top search results are the best sources of information to address their needs, which is often not the case. However, search engines have gradually given way to chatbots, which are models of generative AI and large language models. Large language models (LLMs) are a class of deep learning architecture designed to recognize and produce human-like languages. Chatbots such as ChatGPT, Google Bard, or Claude are built on the transformer model, utilizing self-aware language processing for Natural Language Processing (NLP) and Reinforcement Learning (RL) to identify complex relationships between words. These multimodal generative AI systems have attracted considerable attention from mass media during the recent years (3, 4).

Quick access to information and ease of data gathering from chatbots, such as ChatGPT, are the main prompts for infertile couples to use chatbots for their inquiries rather than visiting IVF clinic staff and infertility treatment professionals. Chatbots can translate medical information in an easier way for the general public to deeply understand and improve their level of knowledge and information. Such preliminary knowledge would facilitate patients' participation during the diagnosis and treatment procedure. In addition to maintaining anonymity and privacy, infertile couples feel more comfortable using digital tools like ChatGPT compared to receiving information from healthcare professionals. In addition, they find the exact answers to their most private questions that they may not feel convenient to share even with the closest family members (3).

The current limitation in using chatbots involves reliance on more familiar bots like ChatGPT. However, similar models such as Cloud, Microsoft Bing, and Google Bard are alternative options for addressing the needs of patients. Despite providing quick responses to patient requests, there is a possibility that chatbots are using data from unreliable sources, so that the consistency of responses may be affected during subsequent iterations (3). In one study, frequently asked questions (81 questions) about endometriosis were used to evaluate the accuracy of ChatGPT's responses. An experienced gynecologist assigned a score from 1 to 4 for each answer provided by ChatGPT. In total, 91.4% of frequently asked questions were considered correct. ChatGPT had the highest accuracy in responses about symptoms and diagnosis (94.1%) and the lowest in responses on treatment (81.3%). In another study, the responses of three chatbots were ranked and averaged with the comments and opinions of 3 experienced gynecologists. Comparing the 3 chatbots, it was revealed that Bard had better average scores than ChatGPT or Cloud, and most of the chatbot's responses were correct (5).

All in all, the development of AI and LLM will lead to fundamental changes in the field of reproduction and infertility, which will be as revolutionary as the invention of conventional IVF or ICSI. Currently, the role of the doctor and healthcare staff is to diagnose and choose the best treatment method based on consultation, physical examination, and the results of paraclinical tests. Consequently, the personalized plan would be tailored for each individual. However, due to limited knowledge in various aspects of couples' lives including their behavioral, biological, and medical characteristics, the treatment method chosen by the doctor is not necessarily the best alternative. With the expansion of AI and LLM to evaluate couples' fertility and addressing their needs regarding all lifestyle aspects and characteristics, the proposed treatment will be much more accurate and precise than the status quo of infertility diagnosis and treatment. The new technology would undoubtedly change the practice of infertility treatment in the clinics as well as the role of doctors and specialists. In the near future, it is expected that one couple may arrive at your IVF center requesting IUI, while others may seek TESE/ICSI/eSET, yet the next couple may request ICSI/PGT-SR, with the doctors refraining from intervening in couples' decision for the requested treatment procedure. In this context, the diagnosis and selection of the best treatment method will be assigned to AI. From now on, we have to acknowledge that AI is a very powerful tool for the future since the technology continues to develop and advance in medical equipment and telemedicine, culminating in fundamental changes in treatment sector.

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